EXECUTIVE SUMMARY
OF THE
BASEWIDE ENERGY STUDY
FOR FT. DOUGLAS, UTAH

Final Submittal

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EXECUTIVE SUMMARY

This executive summary of the Basewide Energy Study of Ft. Douglas, Utah is a condensed version of a systematic plan of projects to reduce energy consumption. This summary condenses the Basewide Energy Study into brief discussions of all analytical and engineering results of the study.

Ft. Douglas can achieve a 16.9 percent reduction in energy use with an annual savings of $45,833 if all recommendations in the report are implemented. To accomplish this the post needs to implement five no cost initiations; fund six low cost projects, and submit one project for QRIP funding. The impact of these projects are shown in the current and projected charts in Figure 1.

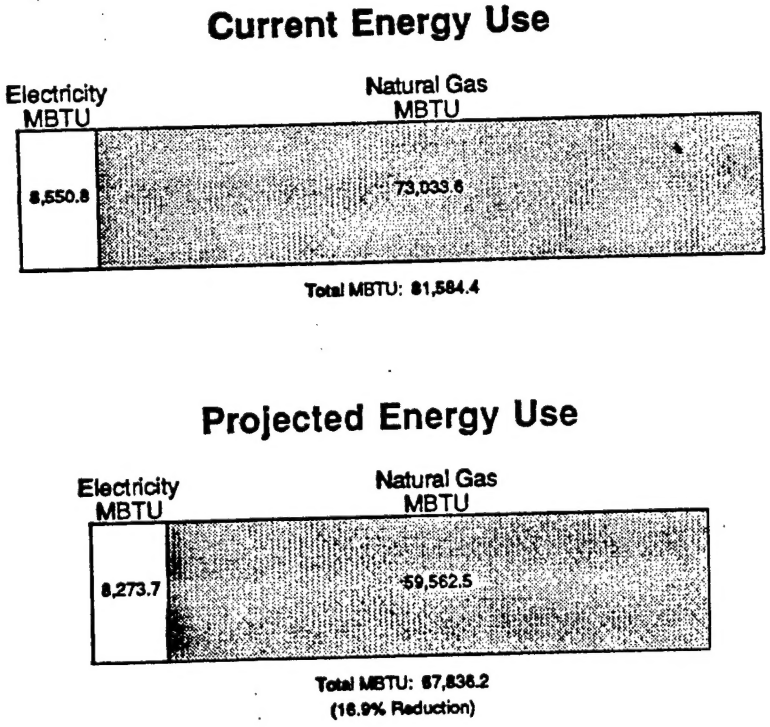

Figure 1. CURRENT AND PROJECTED ENERGY USE AT FT. DOUGLAS

Two operational changes that would further reduce energy consumption were also identified. First, Army Reserve units should coordinate activities and Unit Training Periods (UTP) with the Facilities Engineer so that temperatures can be set back or conversion and distribution systems shut down during periods when buildings are unoccupied. Second, the offices of full-time personnel in Army Reserve facilities should be relocated to a common space to allow set back and/or shut down in the absence of UTP schedules.

These five initiatives will result in an additional energy equivalent savings of 1,466 MBtu per year and an annual cost savings of $6,297. These five initiatives are shown in Table 1.

Table 1. SUMMARY TABLE OF LOW COST/NO COST PROJECTS

PROJECT	MAN HRS/ YEAR	COST/ YEAR($)	ENERGY SAVED/YR (MBTU)	COST SAVINGS/ YEAR ($)
Shutdown DHW During Summer	22	275	126.7	424
Install Insulation on DHW Tanks--Family Housing	138	2,093	87.0	290
Install Flow Restrictors--Family Housing	33	4,340	133.0	445
Purchase energy efficient equipment: Furnace	--	450	80.0	268
Hot Water Heater	--	150	8.0	27
Maintain Time Clocks	12	160	457.7 48.8*	2,309 776*
Controls	80	1,040	525.0	1,758
TOTAL		$8,508	1,466.2	$6,297

*Electrical Savings

The implementation of all ECOs, the low cost/no cost initiatives, and construction and demolition of facilities planned by Ft. Douglas will result in a 16.9 percent reduction from the FY1985 energy consumption. This is presented in Table 2.

Table 2. PROJECTED ENERGY USE AT FT. DOUGLAS

	NAT GAS MBTU	ELEC MBTU	TOTAL MBTU	FY85 $
FY85 Energy Baseline	73,033.6	8,550.8	81,584.4	$442,028
Post Construction and Demolition	(2,779.7)	23.7	(2,756.0)	($10,581)
Proposed Energy Projects	(9,274.0)	(252.0)	(9,526.0)	($28,903)
Low Cost/No Cost Projects	(1,417.4)	(48.8)	(1,466.2)	($6,349)
TOTAL	59,562.5	8,273.7	67,836.2	$396,195

The study addresses 119 buildings at Ft. Douglas that comprise 816,814 square feet of conditioned space. In the cantonment area, building functions include services, shops, and warehouses. The family housing area has single, duplex, and triplex housing units. The structures of Ft. Douglas include a variety of buildings of different ages, construction and roof types, and areas as shown in Tables 3 and 4 for the cantonment area and the family housing area, respectively.

Energy consumption at Ft. Douglas in FY1986 was the equivalent of 75.99×10^9 Btu. Only electricity and natural gas are used. In FY1986, 2,834,832 kWh of electricity were used, and 64,342.7 MCF of natural gas were used. Detailed calculations of the energy used for heating, domestic hot water heating, air conditioning, lighting, and process loads are included in the study.

Table 3. BUILDING FUNCTIONS AND CHARACTERISTICS IN THE CANTONMENT AREA

CATEGORY	BLDG. NO.	YEAR OF CONSTRUCTION	FUNCTION	WALL CONST. TYPE	FLOORS (INC. BSMT.)	TOTAL SQ FT	HEATED SQ FT	ROOF TYPE
1A	4	1876	Office	Sand/Stone	3	8,145	8,145	Pitch-Asp
1A*	28	1883	Office	Sand/Stone	2	2,796	2,796	Pitch-Asp
1A*	31	1876	Office	Sand/Stone	1	6,290	6,290	Pitch-Asp
1B	5	1904	Office	Brick	3	13,909	13,909	Pitch-Asp
1B	100	1939	Office	Brick	3	71,272	51,981	Pitch-Asp
1B	102	1910	Office	Brick	3	44,822	32,526	Pitch-Asp
1B	103	1910	Office	Brick	3	44,822	32,526	Pitch-Asp
1B	104	1910	Office	Brick	3	8,124	6,976	Pitch-Asp
1B	105	1910	Office	Brick	3	43,474	32,526	Pitch-Asp
1B	106	1910	Office	Brick	3	44,822	32,526	Pitch-Asp
1B	107	1910	Office	Brick	3	44,822	32,526	Pitch-Asp
1B	108	1910	Office	Brick	3	44,822	32,526	Pitch-Asp
1B	214	1905	Office	Brick	1	8,000	8,000	Pitch-Asp
1B	216	1954	Office	Brick	1	1,495	1,495	Pitch-Asp
1B	131	1960	Office	Brick	2	25,062	25,062	Builtup
1C	232	1942	Office	Clay Tile	1	3,432	3,432	Pitch-Asp
1D	35	1942	Office	Wood	1	3,228	3,228	Pitch-Asp
1D	37	1918	Office	Wood	1	417	417	Pitch-Asp
1D	210	1918	Office	Wood	1	14,782	7,532	Pitch-Asp
1D	55	1874	Office	Stucco	1	2,181	2,181	Pitch

Table 3. BUILDING FUNCTIONS AND CHARACTERISTICS IN THE CANTONMENT AREA (CONT.)

CATEGORY	BLDG. NO.	YEAR OF CONSTRUCTION	FUNCTION	WALL CONST. TYPE	FLOORS (INC. BSMT.)	TOTAL SQ FT	HEATED SQ FT	ROOF TYPE
2A*	32	1875	Service	Stone	1	9,693	9,693	Pitch-Asp
2B	36	1932	Service	Brick	1	6,204	6,204	Pitch-Asp
2B	49	1875	Service	Brick	1	10,054	10,054	Pitch-Asp
2B	200	1903	Service	Brick	1	12,221	10,952	Pitch-Asp
2B	202	1910	Service	Brick	1	1,865	1,865	Pitch-Asp
2B	350	1937	Service	Brick	1	2,034	-0-	Pitch
2D	34	1912	Service	Wood	1	400	-0-	Pitch-Asp
2D*	48	1883	Service	Wood	1	2,704	2,660	Pitch
2D	54	1933	Service	Wood	1	7,722	7,772	Pitch-Asp
3B	109	1910	Shop	Brick	1	915	-0-	Pitch-Asp
3C	134	1969	Shop	Concrete Blk	1	12,672	12,672	Builtup
3C	217	1908	Shop	Concrete Blk	1	12,752	11,089	Builtup-Asp
3D	110	1910	Shop	Metal	1	1,800	1,800	Pitch-Metal
3D	111	1943	Shop	Wood	1	2,533	2,533	Pitch-Asp
3D	223	1942	Shop	Wood	1	3,200	3,200	Asp
3D	233	1942	Shop	Wood	1	1,200	1,200	Pitch-Asp
3D	234	1942	Shop	Wood	1	1,120	1,120	Pitch-Asp
4A	101	1886	Warehouse	Stone	1	31,233	15,579	Pitch-Asp
4A	206	1910	Warehouse	Stone	2	13,767	4,140	Pitch-Asp
4A	207	1906	Warehouse	Stone	2	14,450	4,875	Pitch

Table 3. BUILDING FUNCTIONS AND CHARACTERISTICS IN THE CANTONMENT AREA (CONT.)

CATEGORY	BLDG. NO.	YEAR OF CONSTRUCTION	FUNCTION	WALL CONST. TYPE	FLOORS (INC. BSMT.)	TOTAL SQ FT	HEATED SQ FT	ROOF TYPE
4B	39	1876	Warehouse	Stone	1	600	-0-	Pitch
4B	127	1983	Warehouse	Brick	1	6,741	6,000	5 ply Asp Bitup
4C	41	1954	Warehouse	Concrete	1	207	-0-	Concrete
4C	132	1960	Warehouse	Concrete Blk	1	3,821	-0-	5 ply Asp Bitup
4D	38	1915	Warehouse	Wood	1	590	-0-	Pitch-Asp
4C	128	1942	Warehouse	Wood	1	4,560	4,560	Pitch-Asp
4D	235	1942	Warehouse	Wood	1	2,256	2,256	Pitch-Asp
					TOTAL	604,031	454,593	

*Historical Buildings

Function

1 Offices
2 Service
3 Shops
4 Warehouse
5 Family Housing

Wall Construction

A Stone
B Brick
C Concrete Block
D Wood/Frame

Total Area by Function

Office — 436,717 sq ft
Service — 52,897 sq ft
Shops — 36,192 sq ft
Warehouse — 78,225 sq ft

Table 4. BUILDING CHARACTERISTICS IN THE FAMILY HOUSING AREA

CATEGORY	BLDG. NO.	YEAR OF CONSTRUCTION	FUNCTION	TYPE CONST (inc bsmt)	FLOORS	BDRMS	BATHS	ROOF TYPE	TOTAL SQ FT	HEATED SQ FT
5D	2	1884	Duplex FH	Wood/Frame	3	4	3	Pitch	8,197	8,197
5D	16	1884	Duplex FH	Wood/Frame	3	4	3	Pitch	9.105	9,105
5D	17	1884	Duplex FH	Wood/Frame	3	4	3	Pitch	9,105	9,105
5A*	6	1875	Duplex FH	Sandstone	3	4	3	Pitch	7,799	7,799
5A*	7	1875	Duplex FH	Sandstone	3	4	3	Pitch	9,457	9,457
5A*	8	1875	Duplex FH	Sandstone	3	4	2/3	Pitch	9,532	9,532
5A*	9	1875	Duplex FH	Sandstone	3	4	2/3	Pitch	9,423	9,423
5A*	10	1875	Duplex FH	Sandstone	3	4	2	Pitch	9,349	9,349
5A*	11	1875	Duplex FH	Sandstone	3	4	3	Pitch	9,532	9,532
5A*	12	1875	Duplex FH	Sandstone	3	4	3	Pitch	9,432	9,432
5A*	13	1875	Duplex FH	Sandstone	3	4	3	Pitch	9,584	9,584
5A*	14	1875	Duplex FH	Sandstone	3	4	3	Pitch	9,362	9,362
5A*	15	1875	Duplex FH	Sandstone	3	4	3	Pitch	8,122	8,122
5A*	18	1875	Triplex FH	Sandstone	3	6/6/4	3/3/2	Pitch	9,998	9,998
5A*	19	1875	Triplex FH	Sandstone	2	2	1	Pitch	8,225	8,225
5A*	20	1875	Single FH	Sandstone	2	7	4	Pitch	8,501	8,501
5D	56	1916	Duplex FH	Stucco/Frame	3	2	1 1/2	Pitch	3,917	3,917
5D	57	1916	Duplex FH	Stucco/Frame	3	2	1 1/2	Pitch	4,029	4,029
5D	58	1930	Duplex FH	Brick	3	2	1 1/2	Pitch	3,591	3,591
5D	59	1917	Single FH	Asb/Frame	1	2	1	Pitch	1,409	1,409

Table 4. BUILDING CHARACTERISTICS IN THE FAMILY HOUSING AREA (CONT.)

CATEGORY	BLDG. NO.	YEAR OF CONSTRUCTION	FUNCTION	TYPE CONST (inc bsmt)	FLOORS	BDRMS	BATHS	ROOF TYPE	TOTAL SQ FT	HEATED SQ FT
5B	60	1930	Duplex	Brick	3	2	1 1/2	Pitch	3,216	3,216
5D	61	1891	Single	Asb/Frame	3	2	1 1/2	Pitch	1,859	1,859
5D	62	1891	Single	Asb/Frame	3	2	1 1/2	Pitch	1,878	1,878
5D	63	1891	Single	Asb/Frame	3	2	1 1/2	Pitch	1,878	1,878
5B	64	1930	Duplex	Brick	3	2	1 1/2	Pitch	3,216	3,216
5B	65	1930	Duplex	Brick	3	2	1 1/2	Pitch	3,216	3,216
5B	66	1930	Duplex	Brick	3	3	1 1/2	Pitch	4,396	4,396
5D	52	1893	Single FH	Asb/Frame	3	2	1 1/2	Pitch	2,309	2,309
5B	53	1910	Single FH	Brick	3	2	1 1/2	Pitch	2,260	2,260
5B	1	1910	Duplex	Brick	3	4	2	Pitch	5,919	5,919
5B	3	1931	Single FH	Brick	3	4	3	Pitch	4,052	4,052
5B*	21	1931	Single FH	Brick	3	4	3	Pitch	4,186	4,186
5B*	22	1931	Single FH	Brick	3	4	3	Pitch	4,186	4,186
5B*	23	1931	Single FH	Brick	3	4	3	Pitch	4,186	4,186
5B*	24	1931	Single FH	Brick	3	4	3	Pitch	4,186	4,186
5B*	25	1931	Single FH	Brick	3	4	3	Pitch	4,186	4,186
							TOTAL		212,798	212,798

*Historical Buildings

Function

1 Offices
2 Service
3 Shops
4 Warehouse
5 Family Housing

Wall Construction

A Stone
B Brick
C Concrete Block
D Wood/Frame

Total Area Family Housing = 212,798 sq ft

During the field survey conducted in September 1986 and January 1987 the electrical and HVAC distribution systems were evaluated. The family housing exterior electrical systems have been recently (1986) repaired and are in good condition. The main post exterior electrical system is in need of repair and a project is scheduled for FY1988 or FY1989. The Post gas distribution system has recently (1985) been repaired and is in good condition. The steam distribution systems are in need of repair and a low cost project has been developed as part of this study. Also during the field survey personnel were to note the presence of asbestos products. No areas of asbestos were reported as a result of the field inspection.

FY1985 has been selected as the baseline year of energy consumption against which energy conservation opportunities (ECOs) are evaluated. The energy consumption in FY1985 was the equivalent of 81.58×10^9 Btu. Electrical energy use for this year was 2,502,351 kWh, natural gas usage was 70,837.6 MCF. The electrical energy and natural gas consumption for FY1984-86 are graphically presented in Figures 2 and 3, respectively.

To verify the energy consumption at Ft. Douglas a combination of manual computer and calculations were constructed. The results of these analyses, combined with the study of distribution systems and the survey of energy conversion systems, were used to create energy balances for electricity and natural gas. These calculated balances verify the consumption of the fuels as recorded by the utilities' meters. The balance for electricity is shown in Figure 4 and that for natural gas is shown in Figure 5. The relative consumption of energy per square foot of building area is as follows:

- Family housing--104,456 Btu/sq ft
- Shops--157,249 Btu/sq ft
- Warehouses--65,917 Btu/sq ft

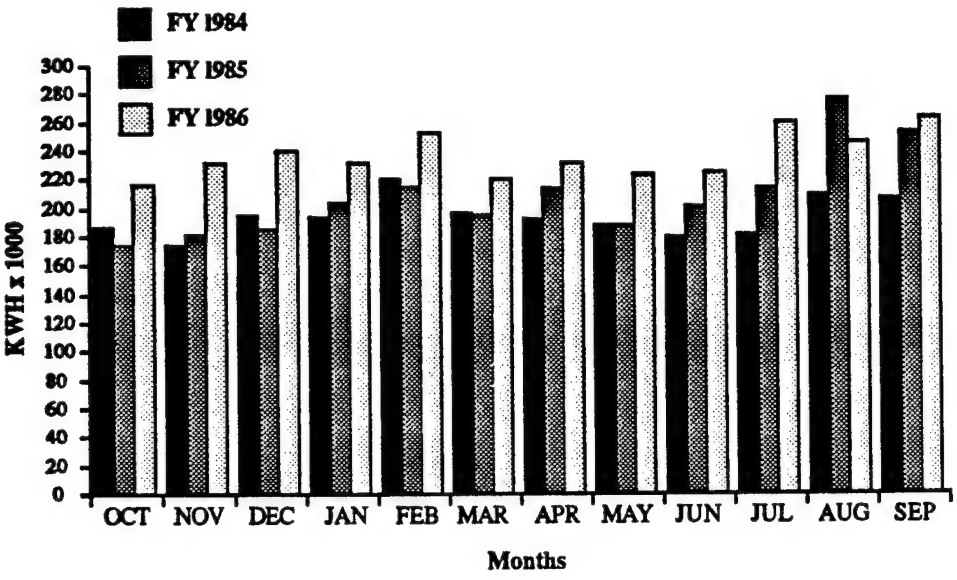

Figure 2. ELECTRICAL ENERGY USE, FY1984-1986

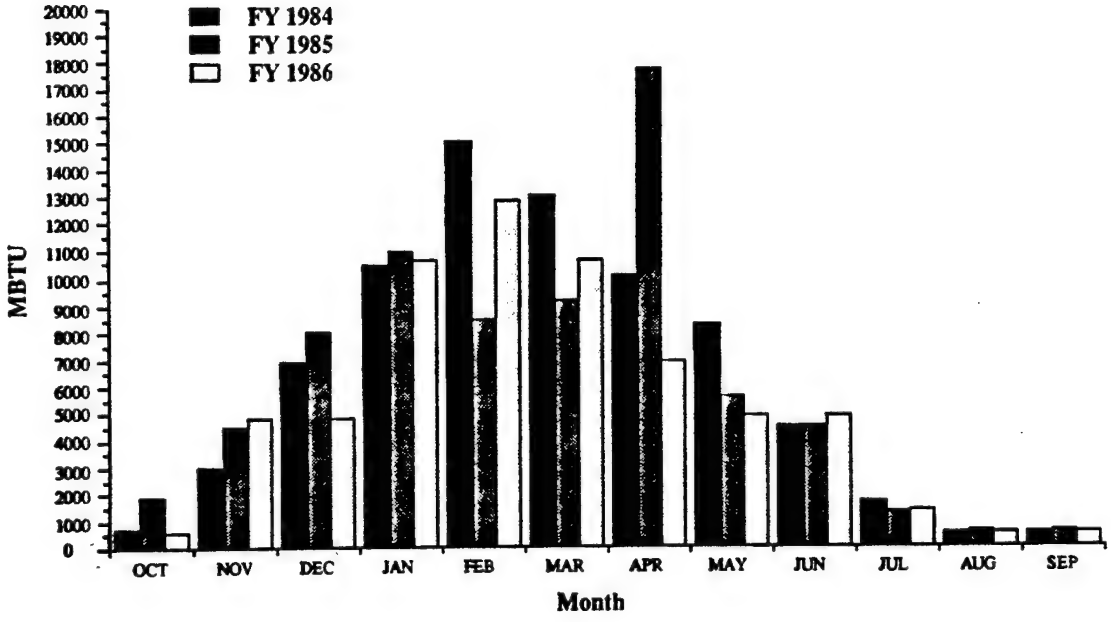

Figure 3. NATURAL GAS USE, FY1984-1986

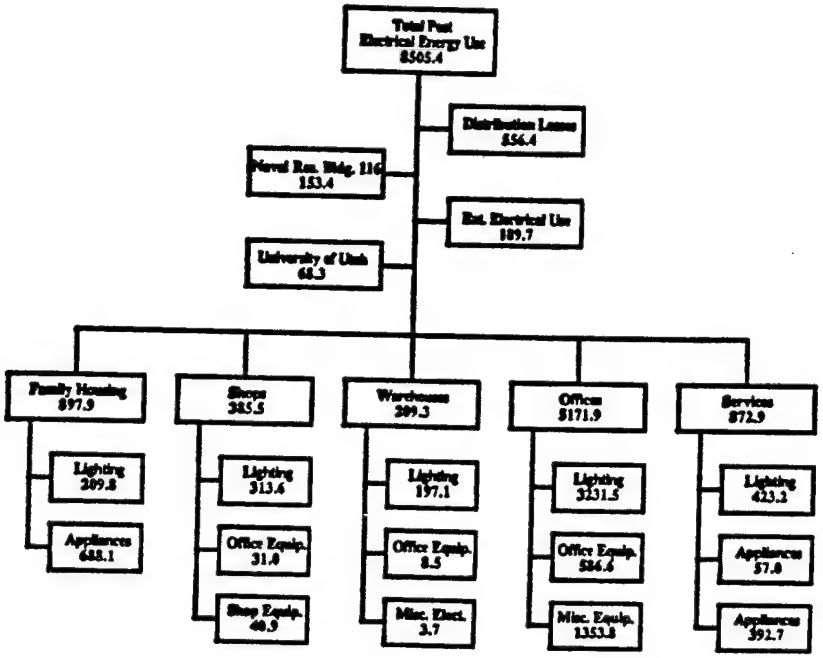

Figure 4. ENERGY BALANCE FOR ELECTRICITY (FY1986)
(totals in MBtu)

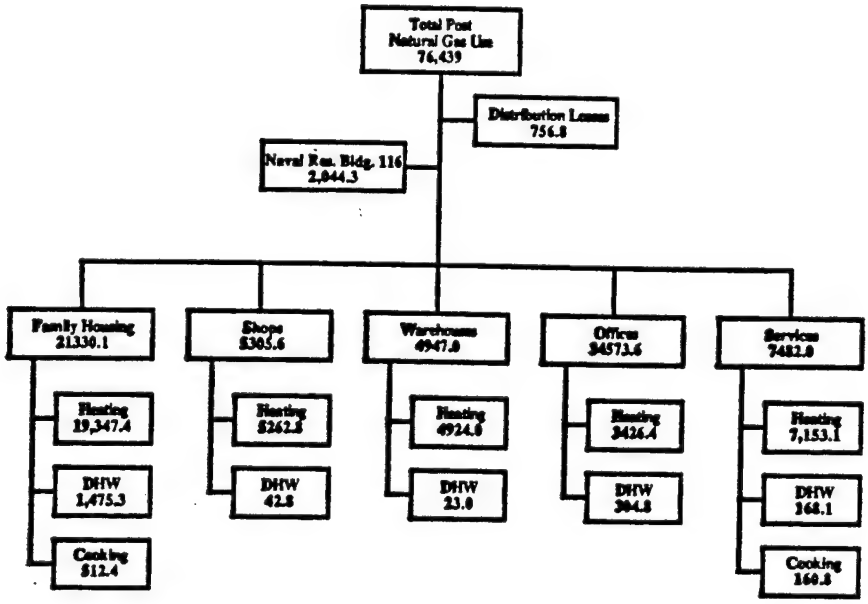

Figure 5. ENERGY BALANCE FOR NATURAL GAS (FY1986)
(totals in MBtu)

- Offices--93,003 Btu/sq ft
- Services--157,946 Btu/sq ft

To analyze the potential for reducing energy consumption at Ft. Douglas, a total of 44 ECOs were investigated. Sixteen of these ECOs were initially determined to have a potential for reducing energy use. All of the ECOs investigated, and those initially determined to be potentially applicable, are shown in Table 5. After further analysis seven ECOs were determined to be cost-effective projects. Many ECOs were rejected for one or more of the following reasons: it had already been adopted, it was inappropriate to the type of distribution or conversion system, or it would have had an adverse impact upon the integrity of historic buildings. The options evaluated and rejected because their SIR was less than 1 are shown in Table 6.

No ECOs meeting the criteria for Energy Conservation Investment Program (ECIP) funding were identified. However, all ECOs were evaluated using ECIP economic criteria in accordance with Increment G of the scope of work. Table 7 summarizes these cost-effective energy conservation projects. A total of 9,526 MBtu of energy equivalent savings are identified in these projects.

Table 5. EVALUATION OF ENERGY CONSERVATION OPPORTUNITIES*

ENERGY CONSERVATION OPPORTUNITIES	APPLICABLE	NOT APPLICABLE
Insulation (wall, roof, pipe, duct, etc.)	•	
Insulated glass or double glazed windows	•	
Weather stripping and caulking		•
Insulated panels		•
Solar films		•
Vestibules		•
Load dock seals/strip doors/air curtains		•
Reduction of glass area		•
Replace inefficient kitchen light fixtures		•
Shutdown energy to hot water heaters or modify controls	•	
Convert to energy efficient lighting sources	•	
Reduce lighting levels		•
Improve power factor		•
High efficiency motor replacement	•	
Night setback/setup thermostats	•	
Infrared heaters		•
Economizer cycles (dry bulb)		•
Control hot water circulation pump		•
FM radio controls		•
Radiator controls	•	
Instantaneous hot water heaters		•
Install shower flow restrictors or limited flow showerheads	•	
Lower domestic hot water temperature	•	

ENERGY CONSERVATION OPPORTUNITIES	APPLICABLE	NOT APPLICABLE
Heat reclaim from hot refrigerant gas	•	
Reduce air flow		•
Prevent air stratification	•	
Install time clocks	•	
Boiler oxygen trim control (fixed or portable)		•
Revise boiler controls	•	
Replace absorption chiller with centrifugal chiller		•
Reduce and/or convert to energy efficient street lights	•	
Insulate steam lines		•
Return condensate		•
Heat reclaim from family housing condenser units for preheating of domestic hot water		•
Domestic hot water heat pumps		•
Optimize transformer loading and balancing		•
Revise or repair building HVAC controls	•	
Waste heat recovery	•	
Peak shaving with use of standby generators		•
Thermal storage		•
Insulate doors (exterior)		•
Timer switch for interior lights		•
Motion detector		•
Self-closing faucets		•

*See pages 6-5 through 6-11 in regular report for more detailed explanation.

Table 6. ENERGY CONSERVATION OPTIONS EVALUATED BUT REJECTED DUE TO A SIR LESS THAN ONE

ECO RANK	TITLE	COST	ELECT SAVINGS MBTU/YR	NAT GAS SAVINGS MBTU/YR	TOTAL SAVINGS MBTU/YR	($) SAVINGS/YR	SIR	SPP
8	Solid State Ignition--Family Housing	8,846	0	173	173	580	.97	15.3
9	Flue Dampers—Family Housing DHW	11,527	0	184	184	618	.84	18.6
10	Insulate Hot Water Tanks--Main Post	2,378	0	36	36	121	.66	19.6
11	Flow Restrictors—Family Hsg Showers	12,910	0	133	133	446	.65	28.9
12	Zone Control W/T Stats	32,016	0	806	806	2,699	.62	11.9
13	DHW Tank Insulation--Family Housing	4,517	0	51	51	169	.54	26.7
14	EMCS	256,700	1132	5677	6809	37,011	.40	6.9
15	Storm Windows	4,841	0	37	37	125	.22	38.7
16	Double Glaze Windows	323,489	0	1107	1107	3,709	.19	87.2
17	Site Lighting	5,462	2	0	2	25	0	218.5
18	Heat Recovery for DHW HTG	9,257	0	12	12	39	0	237.4
19	Temperature Stratification	2,921	-4	16	12	-10	0	0

Table 7. SUMMARY OF RECOMMENDED ENERGY CONSERVATION PROJECTS

ECO RANK	TITLE	COST ($)	MBTU/YR NAT GAS SAVINGS	MBTU/YR ELECT SAVINGS	TOTAL SAVINGS (MBTU/YR)	SAVINGS ($/YR)	SIR	SPP
1	Flue Dampers--Family Housing*	10,185	2,274	0	2,274	7,617	12.20	1.3
2	Repair Steam System**	1,624	259	0	259	868	5.97	1.9
3	Night Setback--Main Post**	26,540	3,096	0	3,096	10,372	3.78	2.6
4	Temperature Controls--Family Housing**	11,221	1,152	0	1,152	3,860	3.66	2.9
5	Insulate Hot Water Pipe**	6,717	447	0	447	1,496	2.76	4.5
6	Ceiling Insulation**	52,187	2,046	0	2,046	6,853	2.23	7.6
7	Energy Efficient Lighting	29,987	0	252	4,000	3,557	1.39	7.5
	TOTAL	$138,461	9,274	252	9,526	$28,903		

* QRIP
** Low Cost/No Cost Projects